

Research Article

Survey of the Aphid Parasitoids (Hymenoptera: Braconidae: Aphidiinae) of Costa Rica with Information on Their Aphid (Hemiptera: Aphidoidea): Plant Associations

Daniel Zamora Mejías,¹ Paul E. Hanson,¹ and Petr Stary²

¹Laboratorio Entomología, Escuela de Biología, Universidad de Costa Rica, A.P.2060, San Pedro de Montes de Oca, 2060 San José, Costa Rica

²Laboratory of Aphidology, Department of Experimental Ecology, Institute of Entomology, Biology Centre, Academy of Sciences of the Czech Republic, Branišovská 31, 370 05 České Budějovice, Czech Republic

Correspondence should be addressed to Daniel Zamora Mejías, zamora.ac.ucr.josedaniel@gmail.com

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Species of Aphidiinae (Braconidae) have never been surveyed in Central America. Here we present the results of an initial inventory of the aphidiine species of Costa Rica and record the presence of ten species (four undetermined), in six genera. The material was obtained by rearing aphids from both crop and noncrop plants throughout the country. In total 2832 aphidiine specimens were reared from 24 species of aphids. *Aphidius colemani* and *Lysiphlebus testaceipes*, which are probably not native to Costa Rica, accounted for nearly 90% of all the specimens. Many of the other aphidiines are also probably exotic species, as are most of their host aphids.

1. Introduction

The primary parasitoids of aphids are restricted to two taxa of Hymenoptera, Aphidiinae (Braconidae) and *Aphelinus* (Aphelinidae), but the vast majority of species and rearing records pertain to the former. Research on the aphid parasitoids of the Neotropical region has been dominated by work done in Cuba [1–6] although some data exist for Mexico [7, 8], Guadeloupe [9], Venezuela [10], Brazil [11], Argentina [12], and Chile [13]. Despite their importance in biological control [14], the species of Aphidiinae (Braconidae) have never been extensively surveyed in Central America.

Knowledge of the aphid parasitoids of this region is important for at least two reasons. First, biocontrol companies are currently offering exotic species for sale in Central America, but before granting permission to these companies, governmental agencies need to know whether a particular commercial species is already present. If it is not present, an

evaluation needs to be done of the potential impact of liberating an exotic species, but this is not possible if the existing parasitoid fauna is unknown. Second, aphids are among the very few groups of insects in Central America where the vast majority of species are not native. About 90 aphid species are reported from Costa Rica and the vast majority of these are probably not native to the country [15]. About 37.5% of the Costa Rican aphid species are Nearctic, 34.1% Palearctic, 14.8% Oriental, 6.8% Neotropical, and 6.8% are of unknown affinities [16]. Thus, it might be predicted that most of their parasitoids are also exotic species, having been intentionally or inadvertently introduced in the recent past. In this respect, a possible environmental hazard following an introduction of a biocontrol agent is negligible.

The objective of this study is to provide initial survey of the primary aphid parasitoids present in Costa Rica and to evaluate the geographic affinities of these species, in particular, which ones are native and which ones are exotic. The data presented here treat only primary parasitoids;

hyperparasitoids were also reared, but these will be treated in a separate publication.

2. Materials and Methods

Aphidiine parasitoids were obtained by collecting as many aphid species as possible from their host plants throughout various locations in Costa Rica. Aphid populations sampled in the field varied in size, and approximately 25 to 200 aphids were taken per sample. A subsample of 5–70 aphids was preserved in 70% ethanol for later identification. When the identity of the plant was unknown samples were dried in a plant press for later identification. GPS Garmin Etrex was used for recording the geographic coordinates and elevation of each site where aphids were collected. Arc Map 9.2 software was used to create the parasitoid distribution map (Figure 1).

Each part of plant sampled with aphids was placed in square plastic containers of 10 cm in length and 10 cm height. The containers were maintained for 25–30 days under a temperature range of 24°–28°C with constant ventilation and light. The samples were checked daily for emerged parasitoids. After emergence, the aphidiine parasitoids were placed in 70% ethanol for identification. The specimens are deposited in the Museum of Zoology at the University of Costa Rica and in P. Starý's collection (České Budějovice). All the material was sampled by the first author who also identified the aphids, with the help of Nicolás Pérez Hidalgo, University of Leon, Spain. The parasitoids were identified by P. Starý.

3. Results

In total, 2832 aphidiine specimens, comprising ten species in six genera, were reared from 24 species of aphids, from a total of 35 localities (Figure 1). Below, the parasitoid species are listed in alphabetical order, along with their aphid and host plants (exotic plants are marked with an asterisk), collecting locality, geographic coordinates, elevation, date, number of specimens (spns.), and (in parenthesis) lot number (Museum of Zoology, University of Costa Rica). Abbreviations used for Costa Rican provinces are Al-Alajuela, Ca-Cartago, Gu-Guanacaste, He-Heredia, Pu-Puntarenas, and SJ-San José.

3.1. *Aphidius colemani* Viereck

Aphis craccivora Koch on *Vicia sativa*. Ca, Cot, 9°53.964'N, 83°52.727'W, 1895 m, 25-VIII-09, 1 spn. (S-133).

Aphis gossypii Glover on *Cyphomandra betacea*. Ca, Tierra Blanca, 9°56.120'N, 83°52.963'W, 2382 m, 4-IX-09, 373 spns., (S-138); SJ, Pérez Zeledón, 9°29.914'N, 83°36.781'W, 1706 m, 20-IX-09, 4 spns., (S-157); Ca, Taras, 9°52.944'N, 83°53.835'W, 1598 m, 30-IX-09, 6 spns., mixed with *Myzus ornatus*, (S-182).

Aphis nerii Boyer de Fonscolombe on *Asclepias curassavica*. Ca, Turrialba, 9°90.291'N, 83°68.561'W, 680 m, 5-X-08, 93 spns., (S-712); Pu, Monteverde, 10°19.150'N, 84°49.428'W, 1317 m, 10-V-09, 13 spns., (S-71); Ca, Cervantes, 9°52.730'N, 83°49.210'W, 1413 m, 23-VII-09, 4 spns., (S-90); Gu, Liberia, 10°33.301'N, 85°23.843'W, 133 m, 31-VII-09, 4 spns., (S-102); on *Gomphocarpus physocarpus**: SJ, Coronado, 9°58.556'N, 84°00.464'W, 1400 m, 15-IX-08, 40 spns., (S-7); on *Gonolobus edulis*: SJ, Montes de Oca, 9°56.380'N, 84°03.003'W, 1214 m, 20-VII-09, 24 spns., (S-125); on *Tabernaemontana alba*: He, San Miguel, 9°58.600'N, 84°04.600'W, 1165 m, 3-VIII-08, 58 spns., (S-1).

Brachycaudus helichrysi (Kaltenbach) on *Ageratum conyzoides*. Pu, Monteverde, 10°19.335'N, 84°49.468'W, 1367 m, 15-VIII-09, 25 spns., (S-115); SJ, Pérez Zeledón, 9°30.057'N, 83°36.817'W, 1721 m, 20-IX-09, 1 spn., mixed with *Myzus ornatus*, (S-156); on Asteraceae: Ca, Cerro Buena Vista, 9°44.514'N, 83°57.002'W, 2112 m, 20-V-09, 1 spn., (S-53); on *Emilia sonchifolia*: Ca, Coris, 9°51.227'N, 83°59.379'W, 1498 m, 08-VIII-09, 8 spns., (S-105); Ca, Paraíso, 9°49.103'N, 83°51.530'W, 1303 m, 08-VIII-09, 1 spn., mixed with *Aulacorthum solani*, (S-106); SJ, Desamparados, 9°54.205'N, 84°02.429'W, 1199 m, 8-VIII-09, 16 spns., (S-110); SJ, Pérez Zeledón, 9°30.008'N, 83°35.783'W, 1675 m, 20-IX-09, 39 spns., (S-155); on *Senecio grandifolius*: Ca, Oreamuno, 9°58.557'N, 83°50.580'W, 3345 m, 14-VIII-08, 83 spns., (S-3), 25-III-09, 7 spns., (S-25); on *Solanum* sp.: SJ, Cerro Buena Vista, 9°40.727'N, 83°52.755'W, 2465 m, 29-IX-09, 77 spns., mixed with *Myzus ornatus* and *Rhodobium porosum*, (S-179).

Myzus ornatus Laing on Asteraceae. SJ, Montes de Oca, 9°56.345'N, 84°02.836'W, 1184 m, 29-IV-09, 1 spn., (S-42); on *Cyphomandra betacea*: Ca, 9°52.944'N, 83°53.835'W, 1598 m, 30-IX-09, 6 spns., (S-182); on *Rubus urticifolius**: Ca, Cerro Buena Vista, 9°33.736'N, 83°44.421'W, 3161 m, 2-V-09, 4 spns., mixed with *Aphis gossypii*, (S-47); on *Rumex* sp.: SJ, Cerro Buena Vista, 9°41.281'N, 83°54.019'W, 2520 m, 25-IX-09, 2 spns., mixed with *Brachycaudus helichrysi*, (S-176); on *Solanum* sp.: SJ, Cerro Buena Vista, 9°40.727'N, 83°52.755'W, 2465 m, 29-IX-09, 77 spns., mixed with *Brachycaudus helichrysi* and *Rhodobium porosum*, (S-179).

Myzus persicae (Sulzer) on *Drymaria cordata*. SJ, Montes de Oca, 9°56.380'N, 84°03.003'W, 1214 m, 11-VII-09, 44 spns., (S-81); on *Solanum lycopersicum*: Al, Zarcero, 10°11.058'N, 84°23.472'W, 1648 m, 07-V-09, 9 spns., mixed with *Aphis gossypii* and *Aphis spiraecola*, (S-50).

Pentalonia nigronervosa Coquerel on *Costus pulverulentus*. SJ, Montes de Oca, 9°44.423'N, 83°50.101'W, 1214 m, 22-V-09, 3 spns., (S-57).

Rhopalosiphum maidis (Fitch) on *Zea mays**. SJ, Pérez Zeledón, 9°30.008'N, 83°36.783'W, 1675 m, 20-IX-09, 3 spns., (S-153).

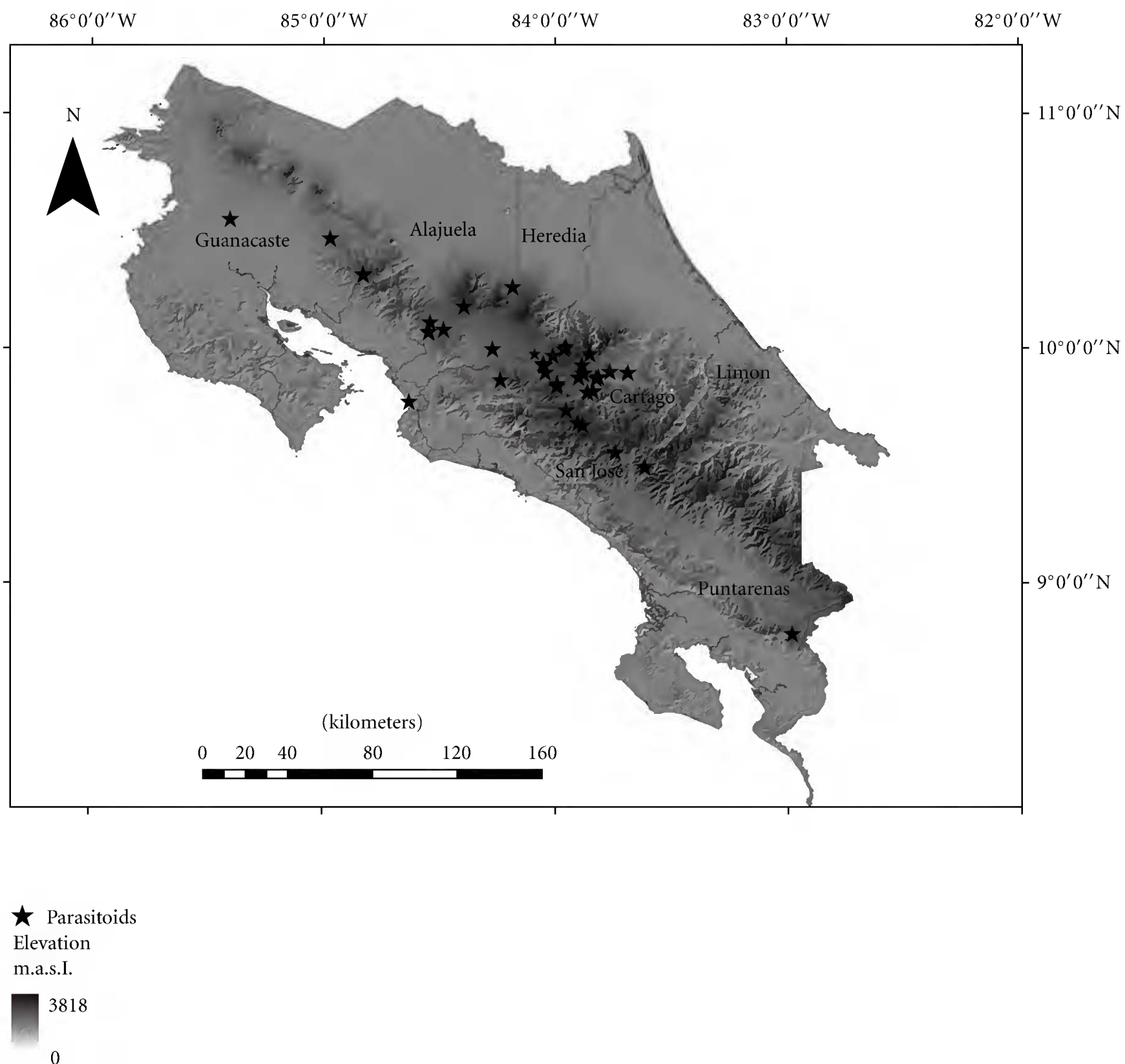


FIGURE 1: Geographic distribution of aphid-Aphidiinae associations in Costa Rica.

Toxoptera citricida (Kirkaldy) on *Citrus sinensis**. Pu, Tárcoles, 9°55.247'N, 84°03.407'W, 60 m, 21-V-09, 1 spn., (S-56).

3.2. *Aphidius* sp. near *colemani*

Brachycaudus helichrysi (Kaltenbach) on *Ageratum conyzoides*. Ca, Cot, 9°53.964'N, 83°52.727'W, 1895 m, 25-VIII-09, 19 spns., (S-132); on *Senecio grandifolius*: Ca, Oreamuno 9°58.557'N, 83°50.580'W, 3346 m, 14-VIII-08, 19 spns., (S-3).

Illinoia morrisoni Swain on *Cupressus lusitanica**. SJ, Coronado, 10°00.220'N, 83°57.563'W, 1724 m, 12-VII-09, 5 spns., (S-86).

Macrosiphum salviae Bartholomew on *Morella pubescens*. Ca, Cerro Buena Vista, 9°44.491'N, 83°57.038'W, 2123 m.s.n.m., 20-V-09, 20-V-09, 2 spns., (S-55).

Myzodius modestum (Hottes) on *Polytrichum juniperinum*. SJ, Cerro Buena Vista, 9°41.281'N, 84°54.018'W, 2519 m, 25-IX-09, 1 spn., (S-225).

Remarks. This species is characterized by a combination of 16-17 segmented antenna (19 in males), tentorial index of 0.4, labial palpi 4 segmented, maxillary palpi 3 segmented, and petiole bearing 4 costae (female). It belongs to the *A. colemani* species group and is possibly a distinct species, but its status must await a reexamination of South American material routinely grouped under *A. colemani*. It commonly occurs together with *A. colemani* in the same sample.

3.3. *Aphidius* sp. A

Microparsus (Picturaphis) pojanii (Cermeli et Smith) on *Phlebodium pseudoaureum*. Ca, Cot, 9°53.940'N, 83°52.576'W, 1893 m, 25-VIII-09, 26 spns., (S-128).

Remarks. This species is characterized by combination of 17-segmented antenna, tentorial index of 0.6, maxillary palpi 4 segmented, labial palpi 2 segmented, and petiole costulate anterolaterally.

3.4. *Aphidius* sp. *B. Uroleucon* (Lambersius) *gravicorne* (Patch) on *Conyza canadensis*: SJ, Montes de Oca, 9°55.953'N, 84°02.786'W, 1214 m, 5-IV-09, 4 spns., (S-30).

3.5. *Binodoxys solitarius* Starý

Aphis gossypii Glover on *Cyphomandra betacea*. SJ, Pérez Zeledón, 9°29.914'N, 83°56.781'W, 1706 m, 20-IX-09, 2 spns., (S-157).

Brachycaudus helichrysi (Kaltenbach) on *Asteraceae*. Ca, Cerro Buena Vista, 9°44.514'N, 83°57.002'W, 2112 m, 20-V-09, 1 spn., (S-53); on *Nasa triphylla*: SJ, Coronado, 10°00.784'N, 83°57.101'W, 1758 m, 9-VIII-09, 4 spns., mixed with *Myzus persicae* and *Lipaphis erysimi*, (S-112).

Myzus ornatus Laing on *Lamiaceae*. SJ, Cerro Buena Vista, 9°40.727'N, 83°52.755'W, 2465 m, 2 spns., (S-177).

Toxoptera aurantii (Boyer de Fonscolombe) on *Cuphea appendiculata*. SJ, Mora, 9°52.267'N, 84°1°4.029'W, 1207 m, 11-VIII-09, 2 spns., mixed with *Aulacorthum solani*, (S-113).

3.6. *Binodoxys* sp. (Male). *Aulacorthum solani* (Kaltenbach) on *Bocconia frutescens*: SJ, Coronado, 9°58.556'N, 84°00.464'W, 1402 m, 18-V-09, 1 spn., (S-76).

3.7. *Diaeretiella rapae* (M'Intosh)

Brevicoryne brassicae (L.) on *Brassica campestris*. Ca, Alvarado, 9°52.985'N, 83°48.742'W, 1420 m, 5-VI-09, 14 spns., mixed with *Myzus persicae*, (S-75); Ca, Cot, 9°53.964'N, 83°52.727'W, 1895 m, 25-VIII-09, 8 spns., mixed with *Myzus persicae* and *Aphis spiraecola*, (S-131); Ca, Coris, 9°50.677'N, 83°59.469'W, 1424 m, 8-VIII-09, 21 spns., (S-111).

Lipaphis pseudobrassicae Davis on *Brassica campestris*. SJ, Cerro Buena Vista, 9°11.281'N, 83°54.018'W, 2519 m, 25-IX-09, 38 spns., (S-175).

3.8. *Ephedrus lacertosus* (Haliday)

Uroleucon (Lambersius) *gravicorne* (Patch) on *Rubus* sp.: SJ, Cerro Buena Vista, 9°40.727'N, 83°52.755'W, 2465 m, 25-IX-09, 3 spns., (S-173).

3.9. *Lipolexis oregmae* (Gahan)

Aphis illinoisensis Shimer on *Vitis tiliifolia*. Pu, Coto Brus, 8°46.978'N, 82°58.294'W, 1311 m, 21-III-09, 2 spns., (S-20).

Toxoptera citricida (Kirkaldy) on *Citrus aurantium**. Al, San Ramón, 10°904.676'N, 84°32.447'W, 916 m, 24-V-09, 1 spn., (S-58); on *Zanthoxylum* sp., Al, San Ramón, 10°04.676'N, 84°32.447'W, 885 m, 13-VII-09, 132 spns., (S-68).

3.10. *Lysiphlebus testaceipes* (Cresson)

Aphis coreopsidis (Thomas) on *Bidens pilosa*. Al, La Garita, 10°00.242'N, 84°16.087'W, 847 m, L., 23-IX-09, 2 spns., (S-163).

Aphis gossypii (Glover) on *Bauhinia purpurea**. Ca, Taras, 9°52.944'N, 83°53.835'W, 1598 m, 30-IX-09, 4 spns., (S-181); on *Cyphomandra betacea*: Al, Zarcero, 10°11.058'N, 84°23.472'W, 1648 m, 14-V-09, 200 spns., mixed with *Aulacorthum solani*, (S-45); SJ, Pérez Zeledón, 9°29.914'N, 83°36.781'W, 1706 m, 20-IX-09, 44 spns., (S-157); on *Drymaria cordata*: SJ, Montes de Oca, 9°56.380'N, 84°03.003'W, 1214 m, 11-VII-09, 1 spn., (S-81); on *Jacaranda mimosifolia**: SJ, Montes de Oca, 9°56.380'N, 84°03.003'W, 1214 m, 20-IV-09, 38 spns., mixed with *Aphis spiraecola*, (S-72); on *Lycopersicon esculentum*: Pu, Buenos Aires, 9°90.669'N, 83°76.280'W, 350 m, 25-X-09, 65spns., (S-226); on *Piper* sp.: SJ, Montes de Oca, 9°56.380'N, 84°03.003'W, 1214 m, 11-VII-09, 312 spns., (S-79).

Aphis helianthi Monell on *Furcraea cabuya*. SJ, Montes de Oca, 9°49°423'N, 83°50.101'W, 1214 m. 5-I-09, 12 spns., (S-18); on *Yucca guatemalensis*: SJ, Montes de Oca, 9°49.423'N, 83°50.101'2, 1214 m, 26-IV-09, 31 spns., (S-40).

Aphis illinoisensis Shimer on *Vitis tiliifolia*. Pu, Coto Brus, 8°46.978'N, 82°58.294'W, 1311 m, 21-III-09, 4 spns., (S-20).

Aphis nerii Boyer de Fonscolombe on *Asclepias curassavica*. Pu, Monteverde, 10°19.150'N, 84°49.428'W, 1317 m, 10-V-09, 22 spns., (S-71); on *Gomphocarpus physocarpus**: SJ, Coronado, 9°58.556'N, 84°00.464'W, 1400 m, 15-IX-08, 14 spns., (S-7).

Aphis spiraecola Patch on *Bauhinia purpurea**. He, Cari blanco, 10°16.072'N, 84°10.858'W, 848 m, 26-II-09, 14 spns., mixed with *Aphis gossypii*, (S-21); on *Piper* sp.: SJ, Montes de Oca, 9°56.380'N, 84°03.003'W, 1214 m, 11-VII-09, 312 spns., (S-200); on *Schefflera* sp.: Al, San Ramón, 10°05.182'N, 84°28.673'W, 1098 m, 26-VII-09, 7 spns., (S-99).

Brachycaudus helichrysi (Kaltenbach) on *Gnaphalium* sp. Ca, Cerro Buena Vista, 9°44.482'N, 83°57.054'W, 2122 m, 20-V-09, 1 spn., (S-54).

Hysteroneura setariae (Thomas) on *Paspalum* sp.*. SJ, Montes de Oca, 9°56.345'N, 84°02.837'W, 2122 m, 29-IV-09, 3 spns., (S-43).

TABLE 1: Aphid-Aphidiinae associations in Costa Rica. Note that the record of *Binodoxys solitarius* from *Aulacorthum solani* is actually an undetermined species of *Binodoxys* (see text). Letters refer to provinces shown in map (Figure 1): Al = Alajuela, Ca = Cartago, Gu = Guanacaste, He = Heredia, Pu = Puntarenas, SJ = San José.

Aphid/Parasitoid	Aphidius colemani	Aphidius nr. colemani	Aphidius sp. A and B	Binodoxys solitarius	Diaritiella rapae	Ephedrus lacertosus	Lipolexis oregmae	Lysiphlebus testaceipes
<i>Aphis coreopsidis</i>								Al
<i>Aphis craccivora</i>	Ca							
<i>Aphis gossypii</i>	Ca SJ			SJ				Al Ca Pu He SJ
<i>Aphis helianthi</i>								SJ
<i>Aphis illinoisensis</i>							Pu	Pu
<i>Aphis nerii</i>	Ca Gu Pu SJ							Pu SJ
<i>Aphis spiraecola</i>								Al He SJ
<i>Aulacorthum solani</i>				SJ				
<i>Brachycaudus helichrysi</i>	Ca Pu SJ	Ca		Ca				Ca
<i>Brevicoryne brassicae</i>					Ca			
<i>Hysteroneura setariae</i>								SJ
<i>Illinoia morrisoni</i>			SJ					
<i>Lipaphis erysimi</i>				SJ				
<i>Lipaphis pseudobrassicae</i>					SJ			
<i>Macrosiphum salviae</i>		Ca						
<i>Microparsus pojanii</i>			Ca					
<i>Myzodium modestum</i>		SJ						
<i>Mizus ornatus</i>	Ca SJ			SJ				
<i>Myzus persicae</i>	Al SJ			SJ	Ca			
<i>Pentalonia nigronervosa</i>	SJ							Gu SJ
<i>Rhopalosiphum maidis</i>	SJ							
<i>Toxoptera aurantii</i>				SJ				
<i>Toxoptera citricidus</i>	Pu						Al	Al, Pu SJ
<i>Uroleucon gravicorne</i>			SJ			SJ		

Pentalonia nigronervosa Coquerel on *Costus pulverulentus*. SJ, Montes de Oca, 9°49.423'N, 83°560.101'W, 1214 m, 22-V-09, 143 spns., (S-57); on *Xanthosoma mexicanum*: Gu, Tilarán, 10°28.413'N, 84°57.961'W, 561 m, 17-IX-09, 2 spns., mixed with *Aphis nasturtii*, (S-145).

Toxoptera citricida (Kirkaldy) on *Citrus aurantium**. Al, San Ramón, 916 m, 10°04.676'N, 84°32.447'W, 10-IV-09, 59 spns., (S-33); Al, San Ramón, 10°14.676'N, 84°32.447'W, 916 m, 24-V-09, 6 spns., (S-58); on *Citrus sinensis**: SJ, Montes de Oca, 9°49.423'N, 83°50.101'W, 1200 m, 17-IX-08, 17 spns., (S-9); Pu, Tárcoles, 9°55.247'N, 84°03.407'W, 60 m, 21-V-09, 1 spn., (S-56); Al, San Ramón, 10°4.493'N, 84°323.600'W, 916 m, 25-V-09, 59 spns., (S-59); on *Zanthoxylum* sp.: Al, San Ramón, 10°04.676'N, 84°32.447'W, 885 m, 13-VI-09, 47 spns., (S-68).

4. Discussion

The results of the present study allow us to examine the geographic affinities of the aphid parasitoids found in Costa Rica in order to determine whether they show a pattern similar to that of their aphid hosts, that is, whether a majority of aphidiines are exotic species. The results also

allow a comparison to be made between the host records of aphidiines in Costa Rica (Table 1) and those reported from elsewhere.

Aphidius colemani occurs in warmer regions around the world and is common in South America, but presumably originated in the Oriental region [17]. Based on host records from Venezuela [10], Chile [13], and Brazil [11], it is probable that this species attacks a greater range of aphids in Costa Rica than that reported here. Biocontrol companies are currently selling exotic populations of *A. colemani* in Costa Rica, but the species has probably been in the country for some time.

Binodoxys solitarius was previously known only from Mexico [7], and its occurrence in Costa Rica suggests that this species is native to Mexico and Central America, although this suggestion requires further investigation. The only previous host record (in Mexico) was from *Aphis solitaria* (Baker) but our results document a wider host range.

Diaeretiella rapae is Palearctic in origin but is now cosmopolitan, and is almost exclusive to aphids on crucifers, but it has been reared from aphids on other plant families [10]. *Ephedrus lacertosus* is known from the Palearctic region [18, 19] Thailand [20] and the Nearctic region [21]. The present record from Costa Rica (just one locality) represents

a considerable range extension for this species. It has probably been introduced in the country, but this requires confirmation.

Lipolexis oregmae is originally from the Oriental region and was introduced into the Americas, although it is unclear exactly when, where, and how it was first introduced. Specimens from Guam were released in Florida beginning in 2000 in order to control *Toxoptera citricidus*, an Asian aphid and vector of citrus tristeza virus that invaded the Caribbean basin during the 1990's [22]. However, the third author has specimens of this species that were collected in Florida in 1986 (from Sugarloaf Mountain near Clemont, by S. J. Peck). There were plans to release *L. oregmae* in Jamaica and Dominica, but before this could happen it arrived fortuitously in both countries [23, 24]. Its introduction into Costa Rica was also fortuitous, but it is not known exactly when it arrived.

Lysiphlebus testaceipes is probably originally a North American species but now occurs throughout Central America and most of South America. It has been reared from a wide diversity of aphid species both in Costa Rica (this study) and elsewhere, for example in the Pacific Northwest of the United States [21], Mexico [8], Brazil [11], and Chile [13].

The number of specimens reared of each aphidiine species is as follows: 1105 *Aphidius colemani*, 46 *Aphidius* sp. near *colemani*, 26 *Aphidius* sp. A, 4 *Aphidius* sp. B., 11 *Binodoxys solitarius*, 1 *Bionodoxys* sp., 81 *Diaeretiella rapae*, 3 *Ephedrus lacertosus*, 135 *Lipolexis oregmae*, and 1420 *Lysiphlebus testaceipes*. Nearly 90% of all the specimens reared in this study belong to just two species, *Lysiphlebus testaceipes* (50%) and *Aphidius colemani* (39%). Both of these species have probably entered the country as a result of human activity, as have the next two most common species, *Lipolexis oregmae* (5%) and *Diaeretiella rapae* (3%). It is therefore possible that four exotic species account for 97% of all the specimens.

The question remains whether there are any native aphid parasitoids in Costa Rica. It is possible that *Binodoxys solitarius* is a native species, although most of its host aphids are exotic species. Although the vast majority of aphid species in Costa Rica are exotics, there are a few native aphids, and one might expect there to be a few native parasitoids associated with these aphids. For example, *Microparsus pojanii* is a native aphid species from which we reared *Aphidius* sp. A, but further taxonomic study is required before conclusions can be made regarding the geographic affinities of the four undetermined species found in this study. Other native aphids include *Idiopterus nephrolepidis*, *Impatientinum americanum*, and undescribed species from high altitudes. More collecting, especially at high altitudes, and further taxonomic research are needed before the question of native Aphidiinae can be answered.

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